Rabid Bat diagnosed in Hawaii

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Since 1966, the Hawaii State Government has been conducting Fluorescent Rabies Antibody (FRA) testing on animal brains as part of a statewide rabies-surveillance program. On April 3, 1991, the Department of Health (DoH) laboratory diagnosed the first case of rabies detected in the State. A large brown bat, Eptesicus fuscus fuscus, captured in a transport container that had just been off-loaded from a ship at Honolulu harbor, was caught. It's brain was examinied and showed typical fluorescent staining patterns for rabies virus. The USPHS Centers For Disease Control (CDC) rabies laboratory confirmed the diagnosis 2 days later. The successful interception of this rabid animal was the result of close cooperation between the private sector (Sea Land Service, Hawaiian Stevedores) and the Hawaii State Government Departments of Health and of Agriculture.

Introduction

Hawaii is the only rabies-free state in the United States. Since 1912, the State of Hawaii has maintained a mandatory 120-day quarantine on all incoming dogs and cats to prevent the introduction of rabies into the State[1]. The only current exceptions are dogs and cats flown directly from the United Kingdom, Australia and New Zealand — countries the State acknowledges to be rabies-free by virtue of similar or more stringent surveillance and quarantine programs.

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Rabies surveillance activities conducted by the State, however, extend far beyond the animal quarantine program. In the incident reported here, a number of other state agencies charged with protecting the integrity of the environment played prominent roles in keeping Hawaii free of rabies. The Department of Agriculture's (DoA) Plant Quarantine Branch (PQ), responsible for protecting the State against entry of prohibited foreign plants and animals, captured the bat before it could escape. The DoH's Vector Control Branch, charged with the control of disease-producing/transmitting vectors, caught and killed all mongooses in the area immediately adjacent to the unloading pier. The diagnostic capabilities of this branch, responsible for disease surveillance and investigation, determined that no one who had close contact with the bat had been exposed to rabies.

Case Report

On March 27, 1991, the container ship *Sea Land Hawaii* arrived from California and docked at Sand Island. In the process of unloading the containers, a live bat was discovered by stevedores in a container of automobiles that had been loaded in Oakland, California. The stevedores immediately closed the container and reported it to their supervisor, who notified Sea Land personnel. Sea Land in turn notified the DoA plant quarantine inspector on site. Additional DoA PQ personnel arrived, entered the containers and sealed off the entrance to prevent the animal's escape.

Inside the dark container, they located the bat by flashlight and sound. Wearing protective gloves to avoid being scratched, bitten or contacting its body fluids, the bat was finally captured behind a plywood board in a corner of the container. In the process of extracting the bat, its wing was inadvertently broken. The bat was then placed in a plexiglass container to prevent contaminating the handlers.

The animal was photographed and turned over to DoA PQ animal inspectors for examination by the DoA veterinary laboratory. By the time the pathologist examined the animal on the following day, it had died. Post-mortem examination revealed it was an adult male, insectivorous bat. The only gross lesion observed was the broken wing. The brain was removed and half was sent to the DoH laboratory for FRA testing.

At the DoH laboratory, representative samples of the bat's

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cerebrum, cerebellum and brain stem were taken. The sampling and testing procedure used was based on the CDC's "Laboratory Methods for Detecting Rabies,"[2] with a modification of diluting the conjugate with phosphate-buffered saline. Impression smears of selected regions of the brain material were made on standard glass microscope slides and allowed to air-dry. The slides were fixed in acetone overnight at 4°C and the next morning were removed from the acetone and stored at -20°C.

A proficiency survey set of slides from the State of Maryland (which included a bat sample) was used as a positive control. All slides to be reviewed were allowed to warm to room temperature and air-dry. The bat brain smears were then examined using a fluorescent microscope with appropriate filters.

All smears examined were found to be positive in varying degrees.

The positive test was reported to the DoH Epidemiology Branch on April 3, 1991. On the same day, tissue samples were air-freighted to the CDC in Atlanta. Also on April 3, Epidemiology Branch personnel initiated investigation and control measures to: 1) Determine if the bat had exposed any person or animal to the virus; 2) immediately implement mongoose and feral cat trapping at the pier by the DoH Vector Control Branch, and to have Rapid Fluorescent Focus Inhibition testing (RFFIT) at the CDC of serum specimens of all animals trapped; 3) determine if there were any other animals in the other containers on the same ship; and 4) trace the origin and route of the automobiles in the container and the itinerary of the ship on its route to Hawaii.

It was determined that 8 people had close contact with the bat, but that none of the 8 had been exposed to the rabies virus, ie none had been scratched, bitten or had direct contact with the bat's body fluids. Vector Control personnel set traps in the area 3 times, capturing 7 mongooses; all tested negative on the RFFIT, which measures rabies antibody levels.

No other animals were found in any of the other containers off-loaded from that ship.

The ship had been loaded in Oakland, California, and had made a stop in Long Beach, California before sailing for Hawaii. The 3 automobiles in the container in which the bat was found came from a General Motors plant in Detroit, Michigan, and had been driven from Detroit to Oakland.

On April 5, 1991, CDC telephoned confirmation of the positive laboratory test on the bat brain. Histological examination of the brain by DoA officials had revealed inclusion bodies in brain cells suggestive of rabies.

On April 8, 1991, a joint press release was issued by the DoH and DoA to notify the community of the incident and to report the laboratory confirmation of rabies in the bat.

The entire 3¼ inch bat carcass was shipped to CDC and subsequently to Dr. Denny Constantine in California, an expert on bats. He identified it as a big brown bat, an insectivorous species commonly found throughout the United States. This species previously had never been sighted in Hawaii[3].

Subsequent monoclonal antibody studies[4] on the rabies virus identified it as one common in the western and midwestern United States.

Discussion

Hawaii is the only state in the Union that is rabies free; it is one of the few areas in the world that remains rabies-free because of stringent quarantine of entering pets, and because of regular laboratory testing of such animals for rabies (active surveillance). Because the disease is invariably fatal and its incubation period is so variable in infected mammals and humans, there is continuing concern over any relaxation of the regulations in our surveillance program. This has been addressed numerous times over the years in prior issues of the *Journal* [5,6,7,8].

The potential for ease of entry to Hawaii of rabid bats, as might well have occurred in this incident, is evident when considering national animal rabies surveillance data. In 1990, there were 4,881 cases of animal rabies reported in the U.S.[9], of which 88% were reported in wild animals. Of the total of wild animal rabies, 14.7% were reported in bats. By state, California reported the highest number of bat rabies (105), accounting for 16.5% of reported bat rabies in the U.S. in 1990. Bats were also the second most frequently diagnosed species that had rabies in that state. Because bats can fly and are not ground-based mammals, they have a potential for transmitting the virus over an area greater than that of terrestrial mammals.

Rabies surveillance in Hawaii is a cooperative activity involving many public and private organizations. The State DoH and DoA monitor animal importation in order to prevent the introduction of rabies. DoA programs include plant and animal quarantine, livestock disease control and veterinary laboratory testing. DoH programs include control of zoonoses, fluorescent rabies antibody laboratory testing and vector control. The collaborative surveillance programs center on testing the following:

1) All animals dying or euthanized in the Animal Quarantine Station,

2) all illegally imported mammals,

3) possible exotic pet vectors (eg monkeys) that bite people,

4) Mongooses and stray cats trapped in the vicinity of the Animal Quarantine Station.

Veterinary practitioners contribute to the program by submitting specimens from pets suspected of having central-nervous-system disorders consistent with rabies. Primary care physicians monitor people for possible exposure to rabies by evaluating and providing post-exposure prophylaxis to people in Hawaii who might have been exposed to potentially rabid animals while traveling in rabies-endemic areas. The DoH Zoonoses Section provides assistance to physicians who request it in this area.

Because of Hawaii's rabies-free status, the DoH does not require the reporting of bites by animals, as is required in the rest of the U.S. in rabies endemic areas. The State government does not require or recommend that local pets receive vaccinations against rabies. These monetary savings are part of the substantial economic benefits, in addition to public health and social benefits, of Hawaii's rabies-free status.

The DoH laboratory does not perform the actual work on the live virus in the area of rabies due to the State's rabies-

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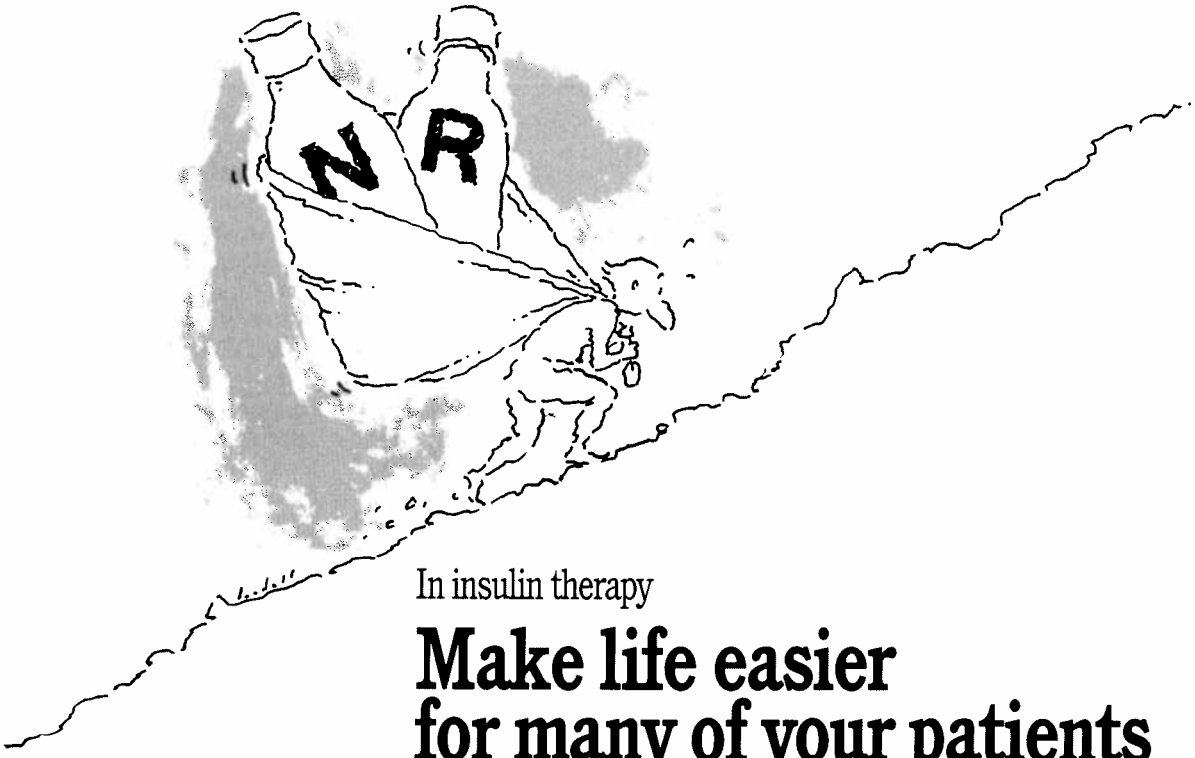

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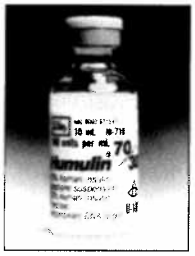

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free status (live rabies virus is not permitted entry into the State even for diagnostic or experimental use), and also because of the lack of adequate containment facilities. The regulatory restrictions pertinent to working with the live virus prohibit the use of supplemental confirmatory testing, such as mouse inoculation or cell cultures that are normally used. As a result, brain smears that show suspicious positivity are sent to the CDC for confirmatory testing.

In 1967, a rabies scare occurred in Hawaii[5]. Due to multiple mistaken laboratory diagnoses and release to the public of an incorrect diagnosis prior to confirmation by a reference laboratory, some 40 animals of various species were erroneously diagnosed as having rabies during a 1-month period. When subsequent testing was conducted at the CDC, all animal samples were negative. However, as a result of the initial alarm, thousands of pets unnecessarily received vaccinations against rabies and hundreds of dogs and cats euthanized. Some 80 people received post-exposure rabies prophylaxis; some had severe side effects from the regimen in use at that time. As a result, the DoH instituted a policy (adhered to in the case reported here) that requires CDC confirmation prior to release of the results to the general public.

Conclusion

The State rabies surveillance program, plus rapid response and reporting by cooperating agencies, prevented entry of the rabid bat into Hawaii. The alertness and cooperation by private agencies (Hawaiian Stevedores, Inc. and Sea Land Hawaii) were exemplary and reflected the effectiveness of the cooperative surveillance program. The continued effectiveness of this program will be enhanced by the support of the medical and veterinary communities, and by the awareness and support of the community.

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